Impact of Colorado's Proposed Nutrient Standards and Resultant Ammonia Emissions from Wastewater Treatment Plants

The Water Quality Control Commission is proposing new nutrient standards for Total Phosphorus and Total Nitrogen to establish protective levels for these nutrients in the surface waters of the state. These new standards may affect the discharge limitations for a variety of sources, to reduce or prevent adverse water quality and aquatic ecosystem impacts. These sources include domestic wastewater treatment facilities (WWTF) statewide. The question has been raised – "Will stricter nitrogen limits for WWTF result in increased ammonia emissions from these facilities?" The simple answer is "No; if anything, the stricter standards will further reduce ammonia emissions from wastewater treatments due to improved multi-stage treatment systems."

For further explanation, the basic domestic WWTF process is depicted in Figure 1. Ammonia emissions result as part of the initial steps: screening and settling/clarification. After the primary clarification process, biological oxidation and denitrification occur, resulting in the simplified reaction below:

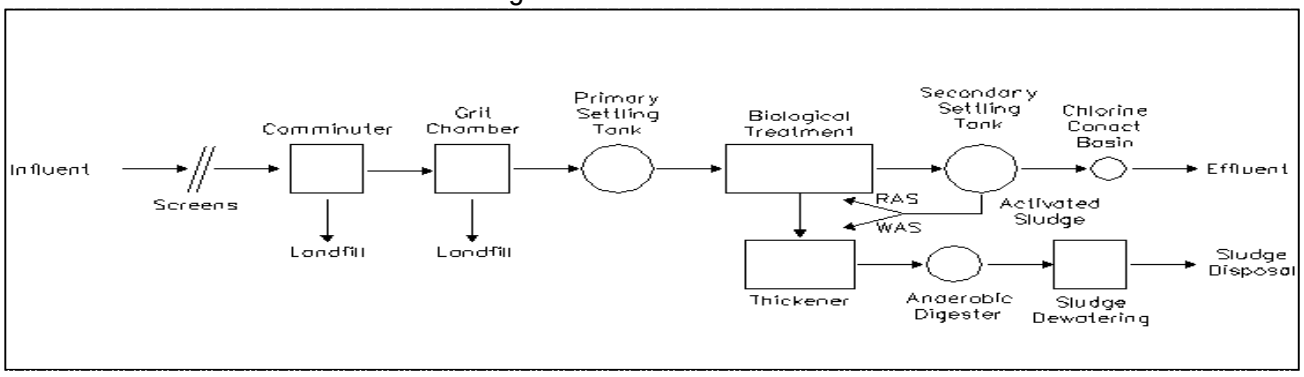
$$2NH_4^+ + 2O_2 \rightarrow N_2 + 4H_2O$$

The common nitrogen removal process used in domestic WWTF is to biologically convert ammonia into nitrite/nitrate (nitrification), and then biologically convert the nitrate into N_2 gas (denitrification) and water. Carbon sources, such as methanol, are sometimes supplied for the dentrification bacteria, resulting in minor methane (CH_4) emissions, as part of the nutrient removal process. Methane is also generated during anaerobic digestion of WWTF sludge.

Wastewater treatment plants subject to the proposed nutrient standards may have to enhance their current treatment or install new multi-stage treatment systems to perform advanced biological nutrient removal. Nutrient removal results in increased N_2 and some methane (CH_4) emissions.

Phosphorus is commonly removed by chemical addition and then ultra filtration after secondary settling, and adds no components to the air.

Figure 1: WWTF Processes



The preliminary ammonia inventory (2008 – 2009 data) estimates that wastewater treatment plants comprise 0.01-0.1% (12-120 tons/year) of ammonia emissions statewide, with 80 to 90% coming from the Front Range[1].

The Water Quality Control Division and the Air Pollution Control Division continue to collaborate on complex issues that affect multiple medium and ecosystems, such as the RMNP Initiative and resultant impacts from new standards.

[1] Inventory estimates vary due to emission factor differences and inventory methodology. The Air Pollution Control Division will likely use highest estimates to be conservative and will update the inventory periodically.